FTC Based Forage Demonstration of Elephant Grass Technology in Ginchi, Wonchi and Debrelibanose District, Oromia National Regional State of Ethiopia

Abstract

The study was conducted in three dairy potential areas of Ginchi, Wonchi, and Debrelibanose districts of Oromia region Ethiopia, to demonstrate promising elephant grass materials to smallholder dairy farmers. As a part of the methodology, a participatory extension approach is employed in this particular study to select a demonstration site. A total of 6 FTC were selected with an area of $10m^2x20m^2$ plot sizes from each district. Elephant grass with accession numbers (14794) material as a candidate along with the check were demonstrated and evaluated for their biomass yield across tested sites. During the implementation phase, on-spot theoretical and practical training was provided to the smallholder farmers, development agents, and agricultural experts of the respective districts. The findings of this research revealed that there was a statistical significant difference in dry matter yield of demonstrated candidate material (accession 14794) over the local check at ($p<0.01$) probability level. And the dry matter yield of the candidate (accession 14794) ranged from 13.50 to 4.92 t/ha with a mean of 9.21 t/ha while the check provided 8.75 t/ha and 3.91 t/ha dry matter yield across the tested site. Moreover, Elephant/Napier grass materials responded differently across the tested sites because of differential responses of the climatic and biotic factors. The best average yield of the candidate (Accession #14794) were recorded at Ginchi district (10.40 t/ha) and followed by Debrelibanose district (8.87 t/ha) as compare to Wonchi district due to field management and another climate variability's. Thus, the study recommended that it's paramount to promote (accession#14794) elephant grass material with its recommended production package for further scaling up and popularization to the study area under similar agro ecology with the joint effort of district office of agriculture, non-government organizations and by other concerned stakeholders.

Keywords: Demonstration; district; Elephant grass; forage; FTC, Ethiopia

INTRODUCTION

Ethiopian smallholder farmers are engaged in a mixed crop livestock farming system and natural grazing land and crop residue is the sole source of livestock feed. Natural pasture, crop residues and crude estimations of the available feed in different parts of the country depicts a deficit to the tone of 35 – 57% even for maintenance [4]. It is unlikely to improve livestock productivity via commercial orientation of the production system without the concomitant intensification in feed production. Research efforts over the last four decades have identified and recommended various high yielding and adaptable forage species in different agro ecological zones of the country.

There is also a growing demand for livestock products in the international markets. The huge livestock resource base and strategic location of the country make it of regional importance for livestock production, supplying neighbouring and Middle Eastern countries that rely on imported livestock and livestock products. Despite growing demand for livestock products both domestically and in the international markets, the rate of return from livestock production has been severely lagged behind the expectation in Ethiopia.

The low productivity of the livestock sector is a result of several limiting factors among which feed is the major one [10]. In spite of serious problems of feed shortage and large number of livestock in the Ethiopian highlands, adoption and popularization of forage crops is very poor [10]. Various efforts have been made by different organizations, often with the support of externally funded projects to promote improved fodder crops to the farming communities. However, adoption of improved fodders by the farming community has so far been very limited and their potential for sustainable feed supply is largely untapped in the country.

“Sustainable livestock production is highly reliant on the accessibility of quality feed and forage resources. Napier grass, also known as elephant or Uganda grass, is one of the very important tropical forage crops. It is extensively used in cut and carries feeding systems [1] and is of growing importance in other agricultural systems”. “Napier grass has many desirable characteristics, including high yield per unit area, tolerance to intermittent drought and high water use efficiency making it forage of choice. It has the ability to persist repeated cutting and will rapidly regenerate, producing palatable leafy shoots” [2].

“Sowing a new pasture or improving an existing natural pasture needs a reliable source of seed or vegetative material or species recommended and adopted for the area” [5]. “Inadequate nutrition and feeding are major limitations to livestock production in Sub-Saharan Africa (SSA). Feeds (usually based on fodder and grass) are either unavailable in sufficient quantities due to changing weather conditions or are available but in a poor quality that they do not provide adequate nutrition” [6]. “These limitations result in low milk and meat yields, high mortality of young stock, longer inter calving intervals and low animal weights” [7]. “Usage of improved forages crops would reduce pressure on natural pasture, improve soil fertility and erosion of marginal lands, improve carbon sequestration to mitigate climate change, support system substantially and enhance natural assets and system reliance [7, 8], for instances some of improved forage species can be used for these above services are Desho grass, elephant grasses, sesbania sebabe, Rhodes, oats, cowpea and others” [3]. Therefore, alternative feed resources like Napier/Elephant grass are indispensable to overcome livestock feed shortage and boost production. Hence, this research activity was proposed to improve livestock feed resource in the study area through Napier/ Elephant grass demonstration on farmers training center with the following objectives.

OBJECTIVES OF THE STUDY;

1. To demonstrate elephant grass feed technology to the study area
2. To avail source of planting material in the study area;
3. To assess the farmers’ perception on the technology ; and
4. To create alternative feed source to the farmers’ so as to improve their livestock production and productivity

3. METHDOLOGY

3.1. DESCRIPTION OF THE STUDY AREA

The study is executed under three districts of west, north and southwest shoa of Oromia region.

Debrelibanose district;

Debre Libanose is one of the North Shewa's thirteen Woredas. Geographically the woreda is found between latitudes of 09^0 43' 30" N longitudes and 38^0 51'0"E latitudes. It's located approximately 104 kilometers from capital of Ethiopia and 14 kilometers from Fiche town, the capital of the North Shewa Zone [11]. The area is characterized by heterogeneous landscape, flora, fauna and habitat types. The land has extremely steep slopes leading up to a strip of plateau. It's bi-modal rainfall pattern starting from 800 mm to 1200 mm with five months of rain (May-September). The season is from December to March. The annual average maximum and minimum temperature of the study area is 230 c and 150 c, respectively [13].

According to the population and housing census by [9] the entire population of the woreda is 62,830. The rural population is 49,776 (79.2%) and therefore the urban population is 13,054 (20.8%). This shows the bulk of the population lives within the rural areas, rest on crop farming. An oversized number of individuals are settled, and also the population is more evenly distributed on the plateau than within the rugged areas where unevenly distributed settlements are common [12]. There are about 81,796 heads of cattle, 8480 goats, 24923 sheep, 10200 equines, and 80,305 poultry within the districts of Debre Libanose woreda where the town is Debre Tsige. All of those livestock species are reared mainly by smallholder farmers under intensive, semi intensive, and extensive production system. The district is divided into 11 administrative PAs and 15,000 liters of milk is collected from [14].

The district's overall area is around 27,500 hectares, with agriculture, pastureland, forest land, and other usage accounting for 23,960 (87.1%), 2,547 (9.3%), 833 (3.0%), and 166 (0.6%) hectares, respectively [12]. The soil texture types of Debre Libanose district are composed of clay soil, silt soil and sandy soil (10%).The predominant soil texture of the district is silt soil which has 57% coverage followed by clay soil (33%) and sandy soil (10%) [12].

Ginchi district

Ginchi is the second district in the Oromia region, which is about 80 kilometres from the capital city Addis Ababa. Ginchi district has a relatively higher population density, according to data from CSA [9], Agriculture is the majority's primary source of income. The main agricultural crops grown in the district include maize, teff, wheat, barley, peas, bean and various types of seeds. Based on figures published by the Central Statistical Agency (CSA, 2007), this district has an estimated total population of 255,896, of which 129,226 are men and 126,670 are women. The same source indicated that 29,602 (11.57%) of its population are urban dwellers, which is less than the Zone average of 12.3%. With an estimated area of 1,549.07 square kilometers, Ginchi has an estimated population density of 165.2 people per square kilometer, which is greater than the Zone average of 152.8.

Wonchi district

Wonchi is the third district located towards south West of Addis Ababa the capital city of Ethiopia. Wonchi district is 155 km from Addis Ababa. The topography ranges from gently sloping to steep hills, with ridges and valleys in between. The district is located between 8°40′ N and 37°55′ E, with elevations ranging from 1700 meters to 3380 meters above sea level. The rainy season is bimodal, with the long rainy season lasting from June to September and the short rainy season lasting from March to April, with the peak record occurring in July and August. The average annual rainfall is between 1650 and 1800 mm, with typical lowest and maximum temperatures between 10 and 30 degrees Celsius, respectively. The study district has a total surface area of 475.6 km^2 and a population of 1, 19,736 people, with 58,671 men and 61,065 women. [15]. Two agro-ecological zones are identified in Wonchi district. These are High land (Dega) areas that accounts for 40% of the district, while mid high land (weynadega) accounts for 60% of the district. The major soil types found in the district are black soil 11%, red soil 46% and mixed soil 43%. Teff (Eragrostis teff), barley, wheat, maize, sorghum, chickpea, bean, pea, lentil, and haricot bean are the main crops grown in the district.

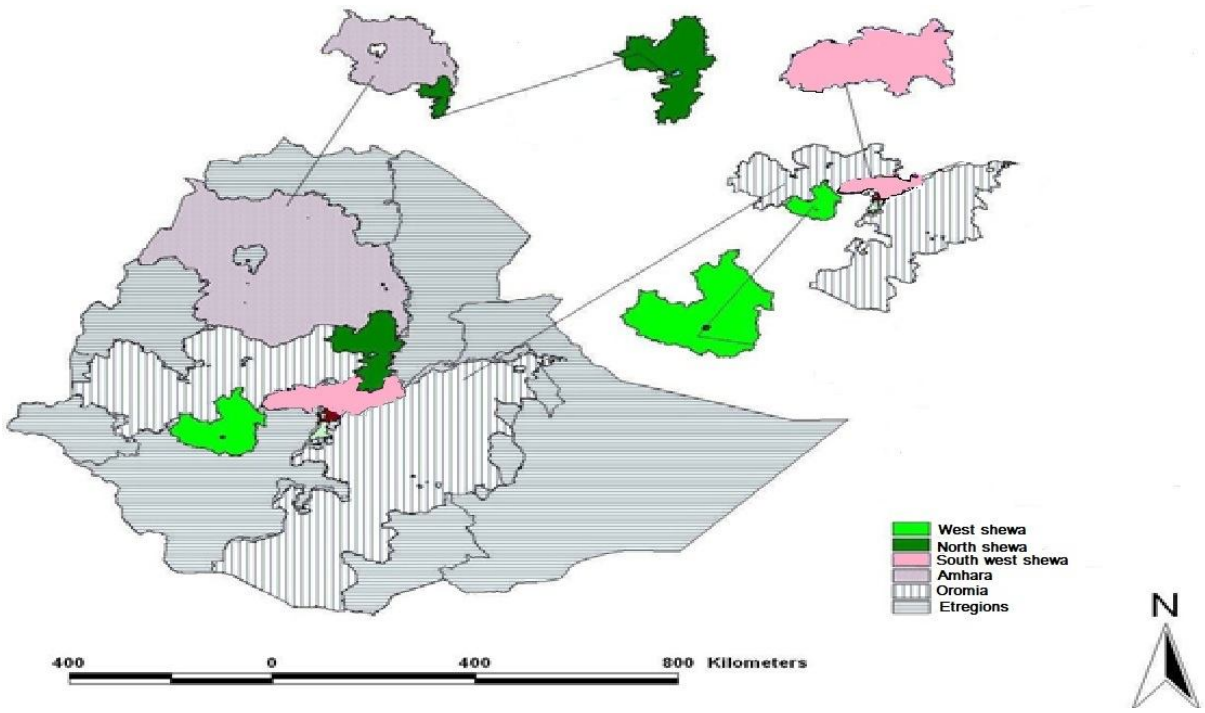

Figure 1. Map of Ethiopia indicating Oromia zones and the study sites West, North and South West Shewa Zone.

3.2. SITE AND FARMERS' SELECTION

The FTCs as research sites were selected purposively based on the potentiality, and appropriateness of the area by considering it free from open grazing, well fenced, has road access, suit for frequent monitoring and evaluation in progress of planting to harvesting, accordingly, Ginchi from west Shewa, Wonchi from south west Shewa and Debrelibanose from north Shewa were selected.

3.3. RESEARCH DESIGN AND IMPLEMENTATION

The demonstration activity is planted in three dairy potential areas namely Ginchi, Wonchi and Debrelibanose. Two (2) FTC from each woredas which is a total of six (6) FTC have been used for the on-farm demonstration of the technology. The demonstration of elephant grass (Accession No.14794 and local check) was established inside FTC area with (10m * 20m) recommended spacing of 1m b/n row and 0.5m b/n plants.

Elephant grass root splitting (Accession # 14794 and local check) were used for this demonstration purpose, because Accession # 14794 variety was being adaptable in tested environment when it was tested on a research station for adaption. Then, root

splits of elephant grass were prepared in form of at least 0.5m-1m (in number 400 -500 root splits per FTC in total of 2400-2500 root splits) were planted on plot size of (10m * 20m) in respect to 0.5 meter between plants and 1meter between rows on farmers training centers.(see Figure 2).

Figure 2. Elephant grass planting operation inside FTCs

3.4. DATA COLLECTION

Both quantitative and qualitative data were collected. Quantitative data is collected using a data collecting sheet, whereas qualitative data is collected using a checklist and personal field observation, individual interviews, and Focus Group Discussions.

3.4.1. AGRONOMIC DATA COLLECTION AND MEASUREMENTS

Measurements made during the experiment season were of the following types: plant height and forage DM yield. Plant height was determined by measuring five culms at random in each plot from the ground level to the highest leaf using a steel tape. For determination of biomass yield, accessions were harvested at forage harvesting stage from two rows next to the border rows of 5 to 10 cm above the ground level. Each plot in the field was weighed to determine the total fresh biomass yield, and a 300 g sample was taken from each plot to the laboratory. Each plot's sample was weighed to determine the sample fresh weight, and then oven dried for 24 hours at 105°C to measure the dry matter yield.

3.5. DATA ANALYSIS

Quantitative data were analyzed using simple descriptive statistics. According to Hejase and Hejase [11], "descriptive statistics deals with describing a collection of data by condensing the amounts of data into simple representative numerical quantities or plots that can provide a better understanding of the collected data" (p. 272). Therefore, this research used means, frequencies, and percentages. While the qualitative data (Data on farmer perceptions and preferences) were collected and subjected to a pairwise ranking technique.

4. RESULTS AND DISCUSSION

Generally the experiment has been done under six farmers training centers with a total of 1200m^2 areas of land at Ginchi, Wonchi and Debrelibanose districts respectively as shown in (Table 1).The performance of each demonstrations were evaluated by pre harvest, post-harvest and perception parameters.

Table 1. Summary of selected FTC site and area coverage of the experiment.

District	FTC's	Area covered
Ginchi	2	
Wonchi	2	Each 10mx20m
Debrelibanose	2	
Total	6	1200m^2

Source: Own computation 2018/19.

4.1. TRAINING ORGANIZED

Training has provided to farmers, DAs and agricultural experts on elephant grass field management/agronomic practice (see Figure 3) in general and on planting, spacing and plant population density(thinning),major maize diseases with their control management, post-harvest management and feeding practice in particular. 80.6 percent (54 out of 67) of the participated stakeholders were farmers, while 19.4 percent were female farmers. (See Table 2).

Table 2. On spot training of farmers and other stakeholders on elephant grass demonstration.

S/N	Participants	Male	Female	Total
1	Farmers	48	13	61
2	DAs	4	0	4
3	District Agri experts	2	0	2
	Total	54	13	67

Source: Own computation 2018/19.

Figure 3. Photos of practical and theoretical training delivered at vegetative stage of the plant**.**

4.2. AGRONOMIC AND YIELD PERFORMANCE

Table 3 describes the yield performances of the demonstrated Elephant/Napier grass varieties across the study site. The yield performances of the improved varieties (Accession #14794 and local) were 10.40, 8.28, 8.87 and 7.69, 5.52, 5.27 ton/ha at Ginchi, Wonchi and Debrelibanose respectively. The highest average yield of the Accession #14794 Elephant/ Napier grass was recorded at Ginchi at 10.40 ton/ha and Debre - Libanose at 8.87 ton/ha as compare to local varieties across the tested FTC sites. This

indicates that this material (Accession #14794) is very adaptable and suit with the existing environmental conditions in these sites. And there was yield difference of the varieties across the tested sites and this variation could be due to rainfall, soil type, management, climatic and other conditions.

Table 3**.** Yield performance of improved elephant grass varieties across districts on FTC.

Districts	Accession Number	No FTC	Std. Deviation	Mean Dry matter (ton/ha)	Maximum	Minimum
Ginchi	14794	2	1.950	10.40	13.50	7.30
	Local	2	1.568	7.69	8.75	6.63
Wonchi	14794	2	1.698	8.28	10.83	5.73
	Local	2	1.690	5.52	7.13	3.91
Debrelibanose	14794	2	1.955	8.87	12.48	4.92
	Local	2	0.339	5.27	6.32	4.21
Total			1.925	5.75	13.50	3.91

Source: Own computation 2018/19.

4.3. YIELD ADVANTAGE

The result indicated (Table 4) that ILRI 14794 variety has better yield of 9.18 ton/ha when compared with local check (6.16 ton/ha). Accordingly, there was yield advantage of ILRI 14794 variety over local check that is 49.1% as depicted in (Table 4) since there was yield of 3.02 ton/ha in comparison and statistically significance different at $p<0.01$.

Yield advantage of the demonstrated varieties was calculated using the following formula.

$$\text{Yield advantage \%} = \frac{Average\ demo\ plot\ yield - standard\ check\ average\ plot\ yield}{standard\ check\ average\ plot\ yield} x\ 100$$

Table 4. Summary of yield performance in study areas.

Accession Number	Average yield ton/ha	Yield difference ton/ha	Yield advantage over the local check (%)
ILRI 14794	9.18	3.02	49.1
Local check	6.16		
Statistically significant difference 1% probability level			

Source: Own computation 2018/19.

4.4. FARMERS' OPINION/PERCEPTION

Farmers set criteria after having awareness about the variety and by using those criteria they gave ranks for the varieties with reasonable remarks during variety demonstration that were: biomass, survival, adaptability, palatability by livestock, and drought tolerant. As a result, most of the farmers' selected ILRI14794 variety and the vicinity farmers started establishing the material on their farm, backyard and on soil and water conservation structures. Selection criteria set as depicted in (Table 5).

Table 5 Ranks of the varieties based on farmers' selection criteria.

Accession/ Varieties	Farmers rank	Reasons	Remarks
14794	1st	Good biomass, good survival ,adaptable, good palatability and drought tolerant	Biomass was measured by Balance in ton, counting the established plants and matured cuttings(survival measurement), gave to livestock(palatability measurement) and produced with existing rainfall
Local check	2nd	Good biomass, good survival ,adaptable, good palatability and drought tolerant	

Table 6. Pair-wise ranking matrix result to rank variety traits.

S/N	Traits	Biomass	Survival	Adaptability	Palatability	Drought tolerant	Frequency	Rank
1	Biomass		1	1	1	1	4	1st
2	Survival			2	2	2	3	2nd
3	Adaptability				3	3	2	3rd
4	Palatability					4	1	4th
5	Drought tolerant						0	5th

Moreover, farmers evaluated these two materials (IRLI14794 and local) at different stages of plant physiology at FTC level based on the following criteria's: good biomass, good survival, adaptable, good palatability and drought tolerant, accordingly, ranked IRLI149794 variety on first rank as compare to local as shown in (Table 5) and even

evaluated these criteria by pair-wise ranking, as result, ranked biomass first with the rest as in (see Table 6). Based on these result and discussion the following conclusion recommendations were derived.

5. CONCLUSION AND RECOMMENDATIONS

The yield performance of the demonstrated elephant grass varieties across the study sites was 9.18 ton/ha for (ILRI14794) and 6.16 ton/ha for local variety, with a yield difference of 3.02 ton/ha, and the candidate accession (ILRI14794) has a yield advantage of 49.1% over local check. As a result, farmers preferred the (ILRI14794) variety due to its high biomass yield, adaptability, palatability, drought tolerance, and other traits.

Demonstration of this material in FTC sites has already created an opportunity for planting material availability or a source of elephant grass to the respective districts. So that, they can utilize elephant grass (ILRI14794) as alternative forage source to overcome the critical feed problem both in quantity and quality in, by employing different improved forage production strategies (backyard production and Contour forage strips) in the study area. Therefore, from this research finding it is recommended that ((ILRI14794) elephant grass material with its recommended production package should be scaled up and popularized to the study area under similar agro-ecology for mass end users through scale up extension approach with the joint effort of district office of agriculture, non-government and other concerned stakeholders.

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